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QUESTIONS AND DISCUSSIONS.

EDITED BY U. G. MITCHELL, University of Kansas.

At the time of making up copy for this issue replies had not yet been received for numbers 4, 8, 12, 13, 16, 20 and further replies are desired for numbers 23, 24 and 25. May we have these for the September issue?

REPLIES.

11. In our courses of study is it desirable to give more consideration to vector analysis? What topics should be included in a first treatment of this subject?

REPLY BY E. L. REES, University of Kentucky.

The writer is much disappointed that question eleven has not elicited sufficient interest to bring forth a full discussion, such, for example, as that on question three. While he feels that synthetic geometry, as outlined by Professor Bussey, makes a very desirable undergraduate course, he also feels that, among the somewhat large number of other possible courses, vector analysis is fully as practicable and valuable as synthetic geometry.

The following, in the opinion of the writer, are some of the merits of such a course:

(*a*) The student's interest in mathematics is stimulated. He is charmed by the symmetry and beauty of the new notation, and, by frequent translations from the vector language to the scalar, he is constantly reminded of the greater brevity and power of the new symbols.

(*b*) The esthetic element, which is so much in evidence in the higher courses of mathematics and which is too often obscured in the grind of the elementary work, impresses itself easily on the student's mind.

(*c*) The student is made to feel the power and comprehensiveness of a new mathematical instrument in the vector methods, without being overburdened and discouraged by the difficulties of the subject.

(*d*) The very wide range of applications serves at once as a review of a large part of his college work and as a means of introducing certain new subjects. This ability to treat such a large variety of subjects, already familiar to the student, by one uniform method, and to introduce entirely new subjects by this method, gives him a more elevated point of view and tends to broaden his mental vision.

(*e*) The student is relieved of the monotony of his other algebraic work by the freshness of a new symbolism with its many interesting interpretations.

(*f*) It affords a most attractive introduction to the theory of space curves and surfaces.

(*g*) Finally, the difficulties of the subject are not too great for students who elect mathematics as their undergraduate major, if only the algebra and a brief introduction to the calculus of a vector function of a scalar be given.

The writer has taught this subject to juniors at the University of Kentucky for a number of years with very satisfactory results. The course has been given by lectures with collateral reading in Gibbs-Wilson and Coffin.

It is hoped that this imperfect discussion will open the way for a much fuller discussion, either by way of criticism or enlargement on what has been written.

25. In an investigation in physics Mr. Mason E. Hufford, 525 S. Park Ave., Bloomington, Indiana, has need of the values of the Bessel functions $J_0(x)$ and $J_1(x)$ for positive real values of x up to $x = 100$. Have tables been constructed to this extent? What is the most ready means by which the desired values may be computed to any required degree of accuracy?

Reply by S. A. Corey, Hiteman, Iowa.

Values of Bessel functions $J_0(x)$ and $J_1(x)$ may, for small values of x, be obtained by ordinary methods of quadrature from the definite integrals

$$J_0(x) = \frac{1}{\pi}\int_0^\pi \cos(x\cos\phi)\,d\phi,$$

$$J_1(x) = \frac{x}{\pi}\int_0^\pi \sin^2\phi\cos(x\cos\phi)\,d\phi,$$

by taking Δx equal to $\pi/9$, $\pi/12$, $\pi/18$, or for greater accuracy still smaller values.

For larger values of x use the asymptotic series

$$J_0(x) = \sqrt{\frac{2}{\pi x}}\left[\cos\left(\frac{\pi}{4}-x\right)\left\{1-\frac{1^2\cdot 3^2}{1\cdot 2(8x)^2}+\frac{1^2\cdot 2^2\cdot 3^2}{1\cdot 2\cdot 3\cdot 4(8x)^4}\cdots\right\}\right.$$
$$\left.-\sin\left(\frac{\pi}{4}-x\right)\left\{\frac{1^2}{1\cdot 8x}-\frac{1^2\cdot 3^2\cdot 5^2}{1\cdot 2\cdot 3(8x)^3}+\cdots\right\}\right],$$

$$J_1(x) = \sqrt{\frac{2}{\pi x}}\left[\left\{1-\frac{(4-1)^2(4-3)^2}{1\cdot 2(8x)^2}+\frac{(4-1)^2(4-3)^2(4-5)^2(4-7)^2}{1\cdot 2\cdot 3\cdot 4(8x)^4}-\cdots\right\}\right.$$
$$\left.\times\cos\left(\frac{3\pi}{4}+x\right)-\left\{\frac{4}{1\cdot 8x}+\frac{(4-1)^2(4-3)^2(4-5)^2}{1\cdot 2\cdot 3(8x)^3}+\cdots\right\}\sin\left(\frac{3\pi}{4}-x\right)\right].$$

These asymptotic series are of such a nature that if we stop the calculations with any term the resulting error is less than the next term. As x increases these series become rapidly convergent, so that any degree of accuracy required in any physical investigation is readily obtainable.

NOTES AND NEWS.

Edited by W. D. Cairns.

"The mathematical analysis of electrical and optical wave-motion" is the title of a book by Dr. Harry Bateman just published by G. P. Putnam's Sons.

Professor H. S. White of Vassar College gave an address on March 5 under the auspices of the Syracuse University chapter of Sigma, his subject being "Mathematics in nineteenth century science."